Recent controversies in neoclassical modelling and developments in Evidence-Driven Policy

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The use of Computable General Equilibrium modelling in evidence-based policy requires an advanced policy making frame of reference, advanced understanding of neoclassical economics and advanced operations research capabilities. This paper examines developments in the policy making frame of reference. The process of evidence-driven policy places importance on the validation of potential policies using models. At national, bilateral and multilateral levels, policy analysis has increasingly relied on neoclassical computable general equilibrium models having substantial precedence. Bayesian analysis suggests that a policy which survives a validation test using such a model has a much better chance of being successful than a policy that fails such a test. Yet the 2008-9 Global Financial Crisis demonstrated that policies verified with neoclassical models neither predicted the Global Financial Crisis nor were able to address it. Governments across the world used massive Keynesian stimulus to restabilise economies. Neoclassical models became much maligned within Keynesian and behavioural economics circles. This paper investigates the continuing role of neoclassical models in evidence-driven policy with reference to the deductivism of Sir Karl Popper and Thomas Kuhn, inductivism and the controversial objective theory of evidence. While policy making has always been messy, in recent decades policy makers may have succumbed to the human fallibility of justifying pragmatism with simplified ideological paradigms that inappropriately place over-reliance on neoclassical free market mathematical models because these models are self-reinforcing of the ideology. It is suggested that future policy making will be even messier, with policy makers placing less importance on such simplified paradigms and taking more responsibility for managing plurality in the political process. It is concluded that neoclassical models will continue to have a role in testing policies but those features of neoclassical models that led to the failures in understanding the Global Financial Crisis will need to be addressed. For example, to be relevant such models will need to close for both households and investment and be cognisant of distributional effects such as the sweep of income to various classes of citizens through wage and taxation policies.

1. Introduction

Computable General Equilibrium (CGE) modelling is a widely used policy tool in the evidence driven policy process. This paper investigates the theoretical underpinnings of evidence driven policy through its unexpected successes and failures. Political economy and neoclassical economics are shown to provide the foundations of consistency for the use of CGE tools in evidence driven policy research. The findings of this research are drawn

together in a comprehensive model for the evidence driven policy process.

2. Evidence Driven Policy

2.1 Evidence Driven Policy Controversy

Science seeks to explain natural laws and the working of the universe through testing theories in controlled experiments ceteris paribus. In contrast, economic and socio-technical problems are huge, holistic and often pressing issues with many feedback loops and dependencies. Such problems are at the core of the fabric of society. They require practical solutions progressed through scenario models having mathematical precision, while at the same time guarding against misplaced confidence in apparently precise numbers and recognising that the results are merely the indicators of possible trends. Examples of relying on mathematical scenario models are policies to deal with global warming and re-engineering the world's financial systems post the 2009 Global Financial Crisis.

The social and economic aspects of policy making characterise it as a major cross-disciplinary area of policy and strategy. Addressing the problem involves many disciplines such as macro and welfare economics, political economy, national, business and industry strategies, security and warfare strategies, finance, valuation, science, technology and engineering, operations research, game theory, philosophy, sociology and psychology.

A torment in global policy making is that many aspects are intensely ideological and subject to overt and covert national and business strategies. The corrosiveness of this mix was demonstrated by the ignominious hiatus to the largest evidence driven policy research project ever undertaken. This was seventeen years of scientific climate research, economic evaluation and national and supra-national policy development following the 1992 Rio Earth Summit, which culminated in the fifteenth meeting of the United Nations Framework Convention on Climate Change Conference of the Parties (UNFCCC COP15) in Copenhagen.

The Copenhagen outcome put to flight the rationally deterministic assumption that evidence objectifies the policy making process, logical policy conclusions follow from a tempered, measured and peer-reviewed process, and that influential people are impressed by the weight of evidence and a transparent and objective process.

Even the Intergovernmental Panel on Climate Change (IPCC), which had so recently shared the 2007 Nobel Peace Prize with Al Gore, emerged from Copenhagen with its reputation impugned through ferocious ideological attacks. Nevertheless, ensuing enquiries into its integrity and the verisimilitude of its evidence found little amiss. For example, Lord Oxburgh (2010), chair of the second of three public interest enquiries into claims of malpractice at the University of East Anglia Climate Research Unit concluded there was "absolutely no evidence of any impropriety whatsoever" and "whatever was said in the [leaked] emails, the basic science seems to have been done fairly and properly." (Adam 2010). Lord Oxburgh added that the assertions drawn from stolen emails appeared to be made by people "who do not like the implications of some the [Climate Research Unit's] conclusions." A previous enquiry by the House of Commons Science and Technology Select Committee had similarly

found no wrongdoing by scientists at the Climate Research Unit.

However, a recent freedom of information order directing Queen's University Belfast to release a researcher's 40 years of dendrochronology data, accumulated using his personal expertise and involving specialised decision-making, threatens to change the established basis of scientists' intellectual property in their data (UK Information Commissioner's Office 2010).

The public expects government to deal with long term issues. In the past, the policy makers have usually carried out their tasks through stakeholder discussion and an incremental approach, shunning media fanfare. Unfortunately, the world's media has proved to be unfamiliar with nature of evidence driven research as an extension of the traditional approach. The media seized on the transparency of the process as providing both an opportunity for its role in giving public expressions to majority views, and as an unexpected smorgasbord of controversial front-page stories. Rarely did the media demonstrate an understanding of the nature of evidence driven policy and the fundamental characteristics of the process, for example, that social issues and some physical science relationships such as man-made or anthropogenic global warming cannot be proven one-hundred percent. Indeed, to do so would require at least two earths, one which we pollute with CO_2 and the other we keep pristine as a control. There is an unresolvable problem when the sample size is just one, which is a world that we all highly value.

Policy makers have long realised, as have legal courts, that there are few universal truths, all evidence is relative and probabilistic and that the concept of scientific evidence is more synonymous with best estimates from necessarily circumstantial evidence. Nevertheless, fuelled by strong differences in views and vested interests, the media pursued its usual trial-by-media investigative path and in the process reported with equal gravity scientific, majority, minority and extremist views. It even legitimised the views of cranks that had no scientific basis at all. This media noise resulted in the scientific and policy messages from the IPCC governments becoming extremely confused. Around the world, the public backed away from the issue.

Scientists learnt from these relentless attacks. For example, in recently releasing climate measurements from more than 100 climate reference stations around Australia, Australia's CSIRO and Bureau of Meteorology (2010) declined to respond to media questions outside those related to the methodology of their data or properly derived conclusions from the data. This steeling of scientists' resolve to deal only with facts and remain distinct from the domain of policy makers heralds a new phase where policy makers will need to face the media exposure of their evidence driven policy process, rather than those scientists and economists who provide the evidence and its interpretation.

While evidence driven policy “hit a wall” in Copenhagen, these ensuing events have shown that evidence based policy making at the level of the global commons has successful survived a severe stress tests. The magnitude of the global clash between ideology and vested interests on the one hand and the evidence based policy process and science on the other has seen evidence based policy reborn through fire, much as the legendary phoenix.

Firstly, the scientific evidence of anthropogenic global warming appears to have remained intact. Secondly, scientists themselves have become significantly more diligent, cautious and shrewd in dealing with ideological and vested interest view points and with the media. Thirdly, the evidence based policy process continues from its Copenhagen hiatus toward another summit at the UNFCCC's November 2010 COP16 Mexico meeting in the city of Cancún.

Lastly, America has begun to address CO_2 pollution in a bipartisan way. In late April 2010, John Kerry (D), Lindsey Graham (R) and Joe Lieberman (I) sponsored a revised Senate Bill for a 17% reduction on 2005 carbon emissions that is widely expected to be passed in the American summer because it accedes to Newt Gingrich's (R) *quid pro quo* demand for U.S. coastal oil drilling. While the Bill proposes a cap and trade scheme to place a price on carbon, President Barack Obama has commented that this may be changed to a carbon tax.

However many countries such as Australia and Germany have decided to await the outcome of the debate on this Bill before moving further on their own carbon pricing schemes. Australia's Greens Party had blocked the Government's Climate Pollution Reduction Scheme because it was unfairly generous to big polluters. On 30 December 2009, the Constitutional Court of France struck down President Nicolas Sarkozy's proposed carbon tax legislation for the same reason (France24 2009). In his April 2008 submission to the Garnaut Climate Change Review, Nettleton (2010a, Appendix A1.1) recommended *inter alia* that Australia await the American decision for reasons that have come to fruition.

2.2 The Service Science of trust strategies in Evidence Driven Policy

Cochran & Malone (1995) define the essence of policy as: “Public policy consists of political decisions for implementing programs to achieve societal goals.” However, this statement is perhaps merely a description of public policy rather than a theory because although it can be used to explain much, in fact it has little value in predicting public policy outcomes or development. Cochran et al. (1993) better captures the scale of the behavioural complexity in policy making “The term public policy always refers to the actions of government and the intentions that determine those actions …. Public policy is the outcome of the struggle in government over who gets what.”

In setting out the basis for a Service Science of climate change policy, Nettleton (2010b) shows that agreeing a set of policies to ameliorate threats to the global commons really means agreeing on a model of how these policies will work. This is because such treaties are in effect alliance contracts based on trust, where each participant shares the profits and correspondingly shares the losses. Unfortunately, as countries are well aware, immediately after an alliance contract is entered into, the conditions that applied at the time will change. Through elections, governments will change, wars will begin, countries will suffer unpredictable earthquakes and tsunamis, and the effect of the contract will work out differently than envisaged. Cultural differences will play a big part. For example, in China a contract is mainly a statement of intentions at the time and often disregarded if new circumstances arise or new market opportunities or alliances present themselves.

As an alliance contract, a climate change treaty needs to be sufficiently flexible to cope with these changes. The people administering the alliance contract need to be able to reappraise changing situations and find other ways to achieve a win-win outcome for all stakeholders. This is not so easy to do when various countries are proceeding to change their institutions on the basis of previous commitments and arrangements.

Policy makers use many techniques in the democratic process of shaping policy amongst stakeholders. These include evidence-based policy, "dialogic" policy development (multiple ongoing stakeholder dialogue) and Lindbloom's (1959) incrementalism or "muddling through" alternative to the rationalist model.

Keane (2009) had discerned a trend towards "monitored democracies," similar to India, where government decisions will be increasingly monitored by many non-governmental organisations. Indeed, Blond (2009) argues that the civil state will be the next evolution of British society, building on the strengths and overcoming failures of both the welfare state and the market state.

In an early 1990s example of this trend, Prime Minister Tony Blair sought to reform United Kingdom government policy and corporate governance with evidence-based policy (United Kingdom Cabinet Office 1999; UK Hampel Committee 1998). Although some would argue that Tony Blair's own Prime Minister's office did not provide a very good example of transparency and evidence-based analysis, the underlying virtuous assumption of evidence-based policy remains undisputed: better policy is achieved with research and evidence that better policy produces better outcomes. In contrast, poor policy usually wastes money and fails to achieve its aims.

2.2 Open and closed institutional philosophies

A debate between Sir Karl Popper and Thomas Kuhn demonstrates an important dimension of evidence driven policy decisions, which is the difference between processes in open evidence based groups and closed establishment groups. This debate was sponsored by Imre Lakatos as part of the International Colloquium in the Philosophy of Science at the former Bedford College, University of London on 13 July 1965 (Fuller 2003, p.10). Five years later, Lakatos (1970) wrote of Popper and Kuhn's diametrically opposed views "The clash between Popper and Kuhn is not about a mere technical point in epistemology. It concerns our central intellectual values, and has implications not only for theoretical physics but also for the underdeveloped social sciences and even moral and political philosophy."

Although both great deductivists subscribed to the process of deduction as being the way forward in science, each had a different view of how this occurred. Thomas Kuhn had shown in *The Structure of Scientific Revolutions* (1962) that the attitude to science in cold-war America was one of protecting the orthodox paradigm from all challenges. This meant that advances occurred in waves rather than linearly. People who wanted to prosper in their career were best advised to keep their heads-down. It could take a decade or even generational change for a new paradigm to become accepted in the scientific community.

Fuller (2003, p.102) notes that Popper found Kuhn's heads-down model abhorrent although,

in the 1965 debate, Popper readily accepted that Kuhn's approach best described the way organisations operated and how science advanced in waves. Nevertheless, he thought it to be an inferior system that should be replaced by the open methodology of critical thinking, passionately providing new ideas for peer review, receiving in return positive criticism and seeking to winnow the set of theories through proactive falsification. Furthermore, Popper claimed that new ideas may die but the careers of the people who have them should not as was found in Kuhn's empirical research. Indeed, Popper suggested that an individual is to be even more respected for learning and moving on to new and hopefully more sustainable theories.

Popper is regarded as one of the first existentialists in science and was knighted for his liberalist, rational and anti-authoritarian values and his concept of advancing science. His main theory of falsification is set out in *The Logic of Scientific Discovery* (1959), originally published in German in 1934 and translated into English by Popper himself in 1959. Popper maintained that the best theory is the one that has withstood the greatest number of falsification attempts. He treats falsification as the cornerstone of the scientific ethic and challenges scientists to test their theories by simultaneously making predictions and using their greatest powers of logic to formulate empirical tests that actively seek to falsify their own theories.

Following Bergson (1932), Popper uses the term open society to describe a classical democracy that is predicated on transparency, debate, accountability and the testing of ideas (Popper 1945). This is very close to an ideal way for a society to advance through evidence driven policy.

While we would like society and its institutions to be completely rational, and we know that the closer we approach this ideal state the better, unfortunately, as Kuhn found, the reality of traditional policy making is that it does not approach this ideal at all. Far from submitting theories to falsification, scientific institutions go to extraordinary lengths to defend their theories against falsification. Also, in the real world the number of confirmations of success is often regarded as more important than the number of times a theory has failed or even survived falsification. For example, an Australian Court of Law will accept widely used rules of thumb as compelling evidence.

Popper's concept of falsification has itself been criticised as a non-falsifiable hypothesis because it cannot be verified through testing. O'Hear (1989) argued that the falsification tests are themselves just theories, so they cannot be true tests of another theory. Curd & Cover (1998) explain the Quine-Duhem Thesis (Duhem 1906) that it's impossible to isolate a single theory for testing from the environment of theories that surround it. So if a cluster of theories is falsified it is not possible to identify the defective element.

Even more broadly, deductivism is itself a hypothesis that cannot be accorded the status of a theory because any proof of deductivism is inconsistent if it relies on any axiom or proof established using deductivist principles. Therefore deductivism is caught by the ultimate paradox that a consistent set of rules cannot establish the validity of that same set of rules. This paradox is illustrated by Kurt Gödel's incompleteness theorems in Mathematics. These

incompleteness theorems prove that it is not possible to find a formal theory (i.e. a set of axioms) that can prove all theories and exclude all falsehoods; and that if a formal theory can be proven consistent from within itself, then it must rely upon itself and therefore be inconsistent (Gödel 1931, Theorems VI & XI).

Despite these vulnerabilities, both deductivism and falsification are widely regarded as useful and powerful formulations for rational scientific enquiry. Ironically, these hypotheses are saved by Kuhn's finding that an organisation (or theory) is not broken just because some things inside it are broken. Therefore, the deductivist paradigm is not broken merely on account that it is unable to self-establish. Perhaps Popper would not be unhappy with this outcome because to do so would have many unreasonable consequences. For example, the identity "1 + 1 = 2" is well accepted as part of the body of common knowledge that every child learns at school. Indeed, if the child does not know this rule then either the child's learning or the school's teaching would be considered grossly deficient. Nevertheless, Gödel's incompleteness theorems declares that this fundamental identity is unprovable and, by extension, render as flawed the whole set of proofs, tests and practices that depend upon it.

Even though deductivism and falsification cannot be proven, it is surprising that Popper's theory remains controversial today as the ideal of falsification has an essential place in science and the technique of criticism has always been used in academic peer review. For example, there are famous experiments where deductivists have developed tests of a hypothesis, such as testing Einstein's theories that light bends and space-time curves. In addition, since 2000, falsification became the fundamental principle for the way software is developed. In test driven development, tests are written before the application code is started and then only sufficient software code to pass the test is actually prepared.

However it has proven extremely hard in general practice to progress science and society through a rigid deductivist discipline of public criticism and falsification. For example, modern political systems are not able to function by hypothesis falsification. Blaug (1992) has pointed out that economic paradigms such as neoclassical economics cannot be subjected to Popperian falsification because a controlled experiment in human behaviour cannot be performed with the holding of other factors constant. It has already been mentioned that global warming cannot be tested ceteris paribus.

Many issues dominate politics. Neither politicians nor the bureaucracy like to encourage negative criticism, even if rationality is identified with the virtues of public criticism and falsification testing. Unfortunately, people are not purely rational beings. They have emotions and much self-esteem and "will to power" invested in certain structures and theories. Therefore people often respond to falsification criticism with a range of emotions from dismay to aggression. Pragmatism, realism, working trade-offs and sub-optimisation are the norm rather than exception. Indeed, the working assumptions of the bureaucracy are rarely, if ever, examined. This is the reality of the messy social milieu for public policy formation.

Instead, the policy making process in democratic societies has traditionally been for politicians to allow public opinion to drift towards a position that the politicians desire, which is then given repeated exposure. Those in a position to know the real situation, the scientists,

journalists and bureaucrats rarely publicise their views because of the risk of career victimisation. This is what Popper called the “spiral of silence”. It is the very reason why the media was originally conceived as a fourth estate, in order to represent the third estate (the people) and give public expression to majority views rather than assume these to be simply self-evident.

Advancing societies through rigid deductive policy making appears to be an unattainable perfection, especially when the dichotomy between open and closed institutions provides a continuing tension in all societies. As the Periclean democracy of Athens proved to be too pure in its principles to stand the test of time against powerful elites, so Popper's open society is considered by the institutions of society to be insufficiently stable for social cohesion.

Nevertheless, it appears to remain a valid hypothesis that the closer falsification can be approached and transparency is valued in the policy making process, the more open and successful economies and business will be. Thus organisations and countries that strive for open principles will not just demonstrate their ethical commitment but maximise economic welfare in their society by providing the conditions of transparency and trust in which people can make their greatest achievements.

2.3. The Objective Theory of Evidence

Influential deductivists such as Sir Karl Popper and Thomas Kuhn would never agree that a clinical trial is sufficient to be sure that a drug will cure the next person tested. Popper's oft-quoted example is that no matter how many white swans are observed, an absolute theory that all swans are white is never justified (Magee 1974, p.22). However, Popper would agree that the more tests a drug withstands without failure then the more robust is the hypothesis of its efficacy.

To Popper's chagrin, instead of working through deduction, society tends to work by induction. This is the evidence driven process to infer generalisations from specific observations by drawing upon bodies of well specified knowledge, the normative working hypotheses that form part of professional systematic practice and through human pattern recognition, intuition and creativity. This creative process is not uncontrolled but subject to various measures of quality assurance such as peer and judicial review. The requirement for coherence and believability of any form of induction is the same as proving a hypothesis beyond reasonable doubt in a court of law. In this tradition, policy makers approach issues as a “historian who sees common tendencies in certain contexts, not a philosopher who seeks clear general principles that apply across contexts” (Brooks 2009).

Evidence-driven techniques place a high value on evidence being consistent and rational in order for confidence to develop in the hypothesis. Historical analysis is an exceedingly important part of establishing consistency because every time an additional observation seems to confirm a theory, the more believable the result becomes.

For example, the scientific method has been exceptionally successful in validating drugs through clinical trials. Leonhardt (2009) observes that policy makers and doctors alike have become perplexed by the plethora of treatments available and the lobbying of drug

companies, device makers, insurers, doctors and hospitals. He notes America's transition to evidence based care where doctors and policy makers, working together and across precedent of circumstances with many nuances, are taking the next step of identifying the best treatment practices among all the alternatives using induction and less than perfect information.

Evidence driven processes that rely on inter-subjectivity are part of the domain of "objective theory of evidence." Even the name is somewhat controversial because each of the words "objective," "theory" and "evidence" have always galvanised a challenge from one philosophical persuasion or another. For example, how could something be simultaneously objective and subjective, or be a theory when it is really an untestable hypothesis, or be evidence when it is really an observation or estimate?

The word "objective" in the title comes from Popper (1972), who proposed that a "World III" of objective knowledge be recognised as a third dimension of existence following the objective and the subjective. This would comprise statute and common laws, scientific papers, textbooks, documented procedures etc. While both Popper's "World III" and the "objective theory of evidence" remain controversial in philosophical circles, these ideas have had a profound influence on normative theories for practical professional practise.

Unfortunately, Popper's World III received the same cold shoulder as had his theory of falsification. Few were prepared to admit the existence of knowledge and institutional structures (for example laws and the police force) that are independent of the knowing subject. Perhaps this is because Popper's World III disrupts the simple Cartesian dualism of mind and body.

The "objective theory of evidence" relies on two primary concepts. The first is that true and false are not absolute states. In *A Treatise on Probability* Keynes (1921, Chapters 15 & 17) hypothesised a continuum between falsity and truth. He suggested that intermediate points in this interval are associated with probabilities of truth. The legal system accepts his proposition, for example, requiring guilt to be proven beyond reasonable doubt in serious cases and on the balance of probabilities in less serious cases.

The second concept in the objective theory of evidence is associated with Thomas Bayes' theorem of conditional probability. This theory of inductive inference provides the mathematics behind Popper's World III and the objective theory of evidence.

2.4 Bayesian analysis

Bayes' theorem states that the probability that a hypothesis is true at a point in time, given certain evidence, is the probability of the past evidence occurring when the hypothesis was true, multiplied by the probability of the hypothesis being true in any case and divided by the probability of the evidence occurring in any case.

Evidence based processes are *prima facie* subjective Bayesian inductive inference due to the subjective assignment of prior probabilities. However, the "objective theory of evidence" holds that these processes have the nature of an "objective theory" because professional researchers have a concern for objectivity and independence in their work, such as

undertaking professional error-statistical practices as part of their methodologies (Mayo 1996; Mayo & Spanos 2004; Staley & Cobb 2009); peer reviewers introduce an inter-subjective due diligence layer because their concern for truth means that research assumptions and results are subjected to informed criticism and repeatability testing (Achinstein 1991; 2001; Rehg & Staley 2008); and Bayesian inference conforms to the "likelihood principle" because it merely depends on prior probabilities, which have nothing to do with the experiment (Birnbaum 1962, p. 271; Sprenger 2008, pp 197 & 204). Therefore, the results emerging from a process that applies the scientific method are qualified to be considered as part of an independent body of knowledge (which is Popper's World III).

Although Birnbaum's "likelihood principle" is highly regarded, it also remains controversial. It is stated as follows, *The likelihood principle (L)*: "In an experiment E with observed data x, all experimental information about v is contained in the likelihood function v->P(x|v). All other information can be neglected. More precisely, if E and E' are two experiments and if the outcomes x and x' generate the same likelihood function, then Ev(E,x) = Ev(E',x'), without reference to the structure of E and E'" Its corollary is that the probability of results that could have been observed is irrelevant to the statistical inference. The "Likelihood Principle" contains the principles of sufficiency (S) and conditionality (C). Birnbaum notes: "The fact that relatively few statisticians have accepted (L) as appropriate for purposes of informative inference, while many are inclined to accept (S) and (C), lend interest and significance to the result, provided herein, *that (S) and (C) together are mathematically equivalent to (L)*" (Birnbaum 1962, p. 271).

Bayes' theory of conditional probability demonstrates the reason why policy makers seek confirmation from economic modellers that a particular policy represents a scenario that is at least feasible. For the purpose of example, it is assumed that economic modelling has a 90% probability of correctly showing a particular policy is feasible, if indeed it is feasible, and that say 60% of all proposed policies are feasible. Therefore the probability of economic modelling identifying that policies are feasible, notwithstanding whether the policy is or is not feasible, is 58%.‡1. Furthermore, the Bayesian probability that a policy is feasible given that modelling shows that it is feasible, is a more impressive 93%.‡2.

The power of this point may be clearly understood in terms of natural frequencies (Gigerenzer 2003, Chapter 4). For example, if 60 out of 100 polices are feasible then economic modelling will on average show 90% or 54 to be feasible. Of the remaining 40 policies that are unfeasible in the original group of 100 policies, 10% or 4 will be incorrectly shown to be feasible. Therefore, a total of 58 will be shown to be feasible although of these only 54 or 93% will indeed be feasible.

This example of applying consistent normative practice in policy modelling shows that feasibility testing has improved a policy maker's chances of a feasible policy from 60 in 100 (60%) to 54 in 58 (93%). However, this analysis also cautions that this powerful demonstration of normative practice is not infallible. Using the above example, 4 unfeasible polices were shown to be feasible and, in addition, 6 policies of the original 60 that are indeed feasible were classed as unfeasible.

The above example is rather static in that it assumes the economic policy modeller to be merely “running a standard test” to check feasibility. However, policy modellers are not outside the test. Instead they are inside the test and influence it as active intuitive beings, on the one hand working incrementally with sensitivities but on the other hand recognising patterns and experimentally reengineering the whole structure of the policy based on their modelling insights from this and other projects and research. In addition, modellers bring their own specialised competences, for example, in Coasian markets or Hick's productivity assumptions (Coase 1960; Hicks 1932). Lastly, policy modellers' normative practice is independently advancing through policy review and learning activities such as continuing professional development. Where policy modellers can reliably discriminate between policies and help to reengineer a better policy then the corresponding “value added” of their normative professional practice is significantly greater.

2.5 Political viewpoints

Conservative and liberal political views dominate the current political environment. Usually, politicians of each persuasion cooperate in forming bipartisan approaches to lawmaking. However, in recent years an extreme polarity has developed between these two viewpoints. This exacerbated lack of cooperation has been dubbed hyperpartisanship. It has also led to new ultra-ideological groups, such as the Tea Party movement in America.

There is bound to be division when a concept emerges from one of the political persuasions, such as evidence driven policy has emerged from political liberal attitudes of transparency and equity. The discipline of moral psychology was established by Lawrence Kohlberg (1969) to understand the difference between conservative and liberal attitudes. An insightful behavioural model has been contributed by Haidt & Graham (2007). This model suggests that five underlying psychological factors characterise emotional reactions in politics. These are harm-care, fairness-reciprocity, ingroup-loyalty (i.e. protect the group or traditions), authority-respect, and purity-sanctity (i.e. religion).

According to Jonathan Haidt's model, people's default attitude is political conservatism with conservatives being broadly pluralist and eclectic across these five factors. Political liberalism exists in nations where the social milieu permits a sort of switching off of the last three dimensions of conservatism. This leaves the moral intuitions of political liberals mainly or even solely based on the factors of harm-care and fairness-reciprocity.

Stephen Clarke (Saunders 2009) explains the authority-respect factor is particularly pervasive with political conservatives. For example, many Americans who endorsed President George W. Bush did so primarily because they believed he upheld morality. Haidt suggests that the strength of the respect-authority factor leads political conservatives to see no inconsistency in decisions being executed with summary justice and implemented expediently. This is of course the antithesis of a liberal desire for a transparent, evidence driven process where decisions are made with input from all the stakeholders to ensure fairness and minimise harm.

Leon Kass (1997) explains why conservatives take this approach to decision making. He argues that political conservatives rely on their gut feel for moral principles and identify any violation as repugnant and, by extension, a pernicious threat to the establishment. This is

Kass' well know “yuck factor.” Abortion, euthanasia and gay marriage are but a few of the issues repugnant to political conservatives on the hard right. By further extension, individuals involved with a violation of the moral principles are characterised as foul and sub-social, deserving of no rights. In addition, political conservatives see no need to explicitly articulate their intuition and prejudices. Haidt notes that conservatives will often change the subject to avoid explaining the basis of their views. Debate is also minimised by appealing to the purity-sancity factor in a way that might seem superstitious to a liberal.

The authoritarian-respect and in-group-loyalty factors have sometimes led to a kind of governmental psychopathy, which has provided plots for many Hollywood movies. Sometimes this governmental psychopathy is exhibited in national policy, for example, governments spying on their own citizens, imprisonment without charge, suspension of *habeas corpus,* kidnapping and rendition, political assassination, torture and public deception.

Is a moot point as to whether the government acts psychopathically or certain psychopathic people dominate government policy. The latter are called “office psychopaths” to distinguish them from serial killers and the like (Clarke 2005).

Unfortunately for conservative politics, Haidt's five factors create a fertile atmosphere in which organisational psychopaths may thrive. This is because the awry delamination of the conservative paradigm into its various psychopathic states, for example bullying and victimisation, is hard to detect because the overtly conservative cloak of an office psychopath is a very effective disguise. Indeed, initially the aberrant behaviour seems to be that of fervent, evangelical conservative. The difficulty in ferreting out office psychopaths is compounded by the multi-agent predator strategies that they employ to amplify their tactics (Axelrod 1984).

Whilst democracies (and corporations) ultimately recognise psychopathic behaviour for what it is, in the very existence of organisational psychopaths there is a classic case of drama. Society suffers a permanent loss, even of things as important as its reputation. Everyone with whom an organisational psychopath comes in contact with has lost whether they know it or not. A particular victim is the company or country that mistakenly supports the organisational psychopath.

In contrast to the attitudes of political conservatives, political liberals call for freedom, autonomy and the right of individuals to express their own preferences. In decision making, political liberals seek principles of equality, natural justice, rational accountability and transparent, evidence based debate. They do not bundle moral values such as loyalty, authority and sanctity into decision making processes such as evidence driven policy. For example, Clarke (Saunders 2009) explains of Haidt's ingroup-loyalty factor: “Conservative morality is the default morality that occurs in most parts of the world …. so most people consider patriotism to be a moral virtue, but a liberal will not consider patriotism to be a moral virtue; they might concede it to be an interesting character trait, but they don't consider it to be a natural morality.”

2.6 Western conservative beliefs and the cusp of change in accepting global resource constraints

In reviewing the failure of the 1992 Rio Earth Summit, German Finance Minister Klaus Topfer noted “I am afraid that conservatives in the United States are picking 'ecologism' as their new enemy” (Greenhouse 1992). Subsequent events bore out Topfer's prediction of intense conservative opposition to global warming. As noted at the start of this paper, this included attacks on environmental scientists, whom they believed to be aligned with an existential threat to American sovereignty and unilateralism.

American and Australian conservative attitudes are starkly at odds with those of their European counterparts. Whereas American conservatives have to date equated the right to pollute the atmosphere with individualism and free markets, conservative European governments see no inconsistency between dealing with global warming and their conservative values (Conason 2009).

The strength and resilience of conservative political opposition was the main reason that President Barack Obama was unable to marshal U.S. Senate support to re-engage with the world on major issues such as greenhouse gas pollution. The U.S. Senate sees itself as the proud defender of American unilateralism and has a history of not supporting any international treaty that constrains America. The U.S. Senate's filibustering of global climate change policy led to an impotence in American policy at the UNFCCC's COP15 meeting in Copenhagen and, as discussed at the start of this paper, to a hiatus in the largest evidence driven policy project ever undertaken.

Yale historian, Paul Kennedy (1993) observed that those people who succeed in democratic political systems usually do so by managing to avoid antagonising powerful interest groups. President Barack Obama has apparently been aware of this issue and sought to bridge enormous ideological schisms in policies for the Global Financial Crisis and Health Care. Yet it remains to be seen if the broad base of Americans will be capable of accepting a new humility of sustainable living where unilateral action to secure energy resources has become an international crime and perhaps, in future, a punishable war crime (Kelly 2010).

3. The Neoclassical Paradigm

3.1 The central role of the Neoclassical paradigm

Classical economics has underpinned Western social and economic development for two hundred years. Many aspects of the core value system of Western free market democracies are embodied in classical economics' mathematical sibling, neoclassical economics. The neoclassical paradigm derives two major strengths from its inextricable links to democracy and capitalism. The first is that the paradigm is internally consistent with independence and unregulated markets and the second is that society has been modified to fit the paradigm. Therefore, the neoclassical paradigm parallels the workings of Western market societies, except in exceptional circumstances.

Challenges from Karl Marx (1867), John Maynard Keynes (1936) and John Rawls (1972)

have served to strengthen the core values of the paradigm rather than weaken it. Indeed, a dramatic reversal of Marx's theory has occurred in recent decades. A declining labour share of GDP and sweep of income to the most wealthy show that the owners of capital have prospered to a far greater degree than the owners of labour (Herbst 2009).

Even proudly egalitarian nations such as Australia have seen inequality strongly rising in the same period for the same reasons. As shown in the Figure 1, Australian companies enjoy a very high and rapidly growing share of factor income. As a result, they are able to pay considerably higher dividends than companies in the rest of the world. Figure 2 shows that this has resulted in the labour share of factor income falling steadily over the last 30 years. This has been exacerbated by the compulsory alienation of individual incomes for retirement superannuation contributions.

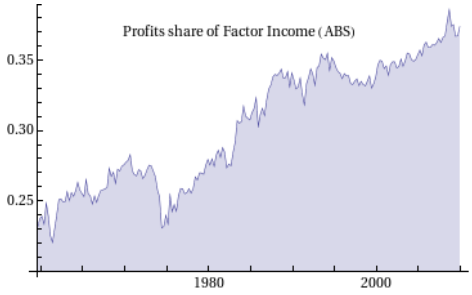

Fig 1. Australian Profit share of Factor Income (Source: Australian Bureau of Statistics 5206.0 Australian National Accounts: National Income, Expenditure and Product, Table 7. Income from Gross Domestic Product (GDP), Current prices)

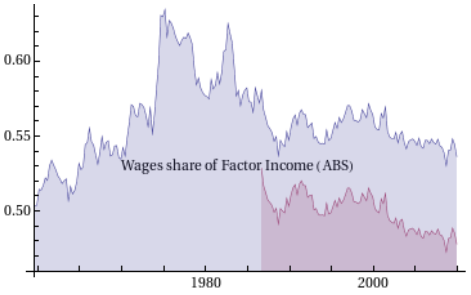

Fig 2. Australian Labour share of Factor Income, before (blue) and net of (purple) superannuation (Source: Australian Bureau of Statistics 5206.0 Australian National Accounts: National Income, Expenditure and Product, Table 7. Income from Gross Domestic Product (GDP), Current prices)

As in America, the depression of labour share of income has been accompanied by a sweep of income to the top 1% as shown in Figure 3 (Atkinson & Leigh 2006). There could only be one result from the pressure on labour share and sweep of income to the most wealthy. Easy money coupled with these financial pressures led to recurrent living expenditure being financed from debt. Figure 4 shows that Australian average private debt to income has risen four-fold from 40% in 1980 to 160% in 2008.

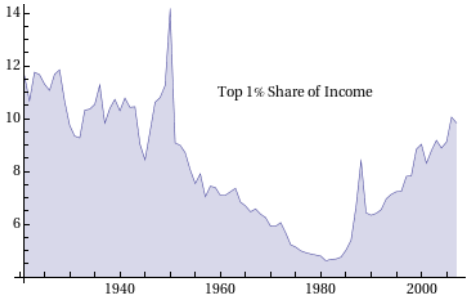

Fig 3. Top 1% share of Australian Income (Source: Atkinson & Leigh 2006, Appendix 6, Table 1, updated to 2007 at andrewleigh.com/?p=2533)

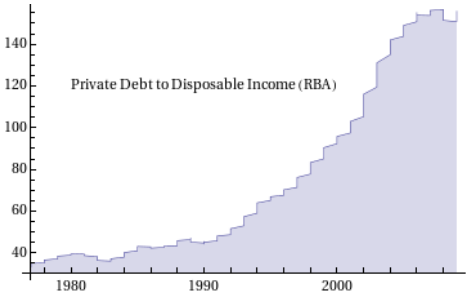

Fig 4. Australian average private debt to income (Source: Reserve Bank of Australia, Statistical Bulletin B21 Household Finances Selected Ratios)

Indeed, American and Australian governments and reserve banks had begun to believe that it was normal for ordinary people to finance their current expenditure by debt rather than income. Although many people scratched their heads over what they knew was a delusion, the system seemed to be sustainable. That is, until the it collapsed in the American 2008 sub prime crisis. Failure to close policy and CGE models for households and socio-economic groups was the reason that neoclassical economics was unable to predict or find a way out of the Global Financial Crisis. This failure of neoclassical economics once again led to it suffering the indignity of emergency Keynesian triage. Banking excesses were merely runaway symptoms of problems whose sources lay with the policy makers not insisting on intertemporal debt neutrality and failing to close their policies and models for households.

The Global Financial Crisis reignited the controversy between Keynesian and neoclassical economics. Implicit in Keynes' theories were two key arguments that upset the classical approach. The first was that the simplicity of classical economics could not cope with economic cycles. The second was that an almost total lack of government business regulation through the 1920s directly contributed to the excesses of the decade, the 1929 Wall Street crash and the ensuing Depression. At that time, as in 2009, many people lost confidence in the ability of classical and neoclassical economics to predict or to fix the market failures. Other notable successes of economic stimulus that Keynesians point to are the rebuilding Western Europe and Japan in the 1950s and 1960s.

3.2 Challenges to the legitimacy of neoclassical economics

Over the last 80 years, it seems that neoclassical economists have led the world into two serious economic collapses. Many economists have asked if rational frameworks of policy testing and analysis are seriously flawed. Mark Dodgson & Eric Beinhocker criticise the fundamental assumption of rationality in neoclassical models “The intellectual field of economics is on the cusp of a big transformation. Mainstream economics is increasingly being seen to be detached from reality. Its assumptions about equilibrium, rationality in human behaviour and the primacy of market forces that are mysteriously asocial make its predictive power extremely limited .... The discipline is suffering, in effect, from the challenge to neoliberal economic doctrine brought on by the [2008-9] sub-prime crisis in the

U.S. and its repercussions across the global financial system. Feeding the mood of despair across financial markets is the perception that mainstream economics was unable to predict the crisis, or to manage it, and has been intellectually enfeebled by the Gordian knot of peak energy prices, planetary overheating and global debt" (Slattery 2008).

The financial crisis has also led to sharply divided opinions between New York Times columnists David Brooks, a classical and behavioural economist, and Nobel Laureate Paul Krugman, a Keynesian economist. Brooks laments that neoclassical models are overly linear and rational, lacking psychological dimensions. He writes "Economic models and entire social science disciplines are premised on the assumption that people are mostly engaged in rationally calculating and maximizing their self-interest …. But during this financial crisis, that way of thinking has failed spectacularly. As Alan Greenspan noted in his Congressional testimony last week, he was "shocked" that markets did not work as anticipated" (Brooks 2008).

Brooks continues his criticism of neoclassical economics "Once, classical economics dominated policy thinking. The classical models presumed a certain sort of orderly human makeup …. the market rewards rational behavior …. The invisible hand forms a spontaneous, dynamic order .... Economic behavior can be accurately predicted through elegant models …. This view explains a lot, but not the current financial crisis — how so many people could be so stupid, incompetent and self-destructive all at once …. This crisis represents a flaw in the classical economic model and its belief in efficient markets …. Democratic discussions of the stimulus package also rest on a mechanical, dehumanized view of the economy. You pump in a certain amount of money and "the economy" spits out a certain number of jobs …. But an economy is a society of trust and faith .... The economic spirit of a people cannot be manipulated in as simple-minded a fashion as the Keynesian mechanists imagine …. Mechanistic thinkers on the right and left pose as rigorous empiricists. But empiricism built on an inaccurate view of human nature is just a prison" (Brooks 2009).

While Brooks has slowly moderated his criticism of the Keynesian stimulus package, his expression of public frustration with existing economic approaches is nevertheless poignant. The most important of these is that models based on consumption growth as society's main goal do not react well in low or volatile growth situations.

Although a Keynesian, Krugman (2009) agrees that the issue with neoclassical models is that they address steady state growth, and do not respond to the rapid dynamics of the economy. Therefore, the problem with neoclassical views of the world lies less with the models and more with policy makers' preoccupation with steady state growth. Perhaps it would be more accurate to note that the mutually reinforcing paradigms of Western free market democracies and neoclassical economic models, together with a long period of post-WWII prosperity have lulled Western politicians and policy makers into the reassurance that a focus on growth is a stable single indicator of economic welfare.

This does not imply that policy makers are unidimensional. Indeed, quite the reverse. It may be recalled from the earlier discussion that policy makers would prefer that economic models are always completely correct. However, policy makers seek confirmation of feasibility from

modellers to improve the probability that their policy will be feasible, not seer-like predictions of the future and iron-clad guarantees of policy outcomes. Policy makers are well aware that the future will unfold quite differently to that forecast in economic models. This is why policy makers chuckle in good humour at John Kenneth Galbraith's quip that "economists were invented to give fortune tellers a good name."

Krugman notes that "the more it changes, the more it stays the same" because only those seeking deterministic mathematical solutions have lost. He concludes that policy formation will always be messy rather than neat and mathematical "As I see it, the economics profession went astray because economists, as a group, mistook beauty, clad in impressive-looking mathematics, for truth …. Until the Great Depression, most economists clung to a vision of capitalism as a perfect or nearly perfect system. That vision wasn't sustainable in the face of mass unemployment, but as memories of the Depression faded, economists fell back in love with the old, idealized vision of an economy in which rational individuals interact in perfect markets, this time gussied up with fancy equations …. It's much harder to say where the economics profession goes from here. But what's almost certain is that economists will have to learn to live with messiness …. In practical terms, this will translate into more cautious policy advice — and a reduced willingness to dismantle economic safeguards in the faith that markets will solve all problems …. flaws-and-frictions economics will move from the periphery of economic analysis to its center …. they'll have to do their best to incorporate the realities of finance into macroeconomics …. It will be a long time, if ever, before the new, more realistic approaches to finance and macroeconomics offer the same kind of clarity, completeness and sheer beauty that characterizes the full neoclassical approach."

It may be concluded from the intersection of these views that neoclassical economics continues to have an important role in policy making. However, policy formation remains a rough and tumble area of politics. With the evolution of monitored democracies, policy makers need to prepare to be accountable in the future for their current policy decisions, as messy as these decisions may be (Keane 2009; Kelly 2010). Therefore policy decisions will need to be documented as evidence driven processes, notwithstanding that these processes may be undertaken without public scrutiny at the time. While policy makers will not be able to rely on simple neoclassical economic prescriptions, neoclassical policy research will remain an essential element of their documented due diligence.

4. General equilibrium in evidence based policy

4.1 Scope of policy research tools

As human societies become more organised and interdependent, policy making needs to expand from addressing issues in the local region to national policy and global policy. This is shown in Figure 5 as a horizontal expansion in policy scope.

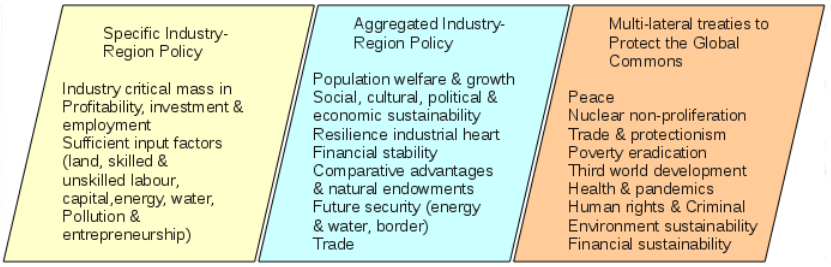

Fig. 5 Policies scope at the industry-region, national and global levels

One methodology rarely encompasses all that needs to be investigated in policy research. Usually, the policy issue is deconstructed into smaller, manageable pieces with an appropriate tool chosen for each research task. Policy analysis becomes the insight developed through iteratively using each tool and ensuring consistent answers.

The importance of historical analysis in developing evidence for consistent and believable hypotheses was referred to in discussing the objective theory of evidence. It would be no surprise that a discovery of the historical background through political economy analysis has become *de rigueur* for research in evidence based policy. This includes ideological analysis in which conservative, liberal, radical and alternative ideologies are considered. Point of view analysis is a similar technique which analyses policies from prominent points of view. This needs to be extended across the whole of the political, economic and social fabric of the system in which the *tétonnement* of marginal social benefit and marginal cost occurs.

The above discussion of modelling and the "objective theory of evidence" showed that policies need to be quantified using mathematical techniques. These techniques include empirical analysis of data using statistical methodologies that measure the impact of government policy on individuals and markets, microeconomic models with indifference curve-budget constraint graphs and equilibrium models for constrained utility maximisation; and supply and demand diagrams for equilibrium and social welfare efficiency.

Equilibrium modelling has two variants: partial and general equilibrium. Marshall's famous microeconomic scissor curves for supply and demand are the classic representation of partial equilibrium analysis (Marshall 1890). Partial Equilibrium modelling focuses on a single commodity and assumes *ceteris paribus* that the supply and demand curves are independent of each other.

Partial equilibrium models are suitable for most regional analysis. In partial equilibrium analysis, major economic parameters such as economic growth are provided exogenously and changes in resources are seen as perturbations to the initial equilibrium. For example, changes to the demand curve do not affect the supply curve.

Figure 6 shows that partial equilibrium modelling has proven suitable for regional and national policy research. However, the effect of global policies on national and regional

industries in the presence of trade flows necessitates general equilibrium techniques.

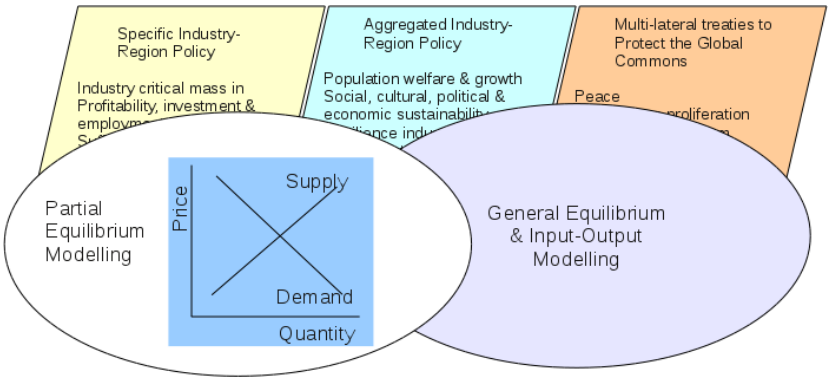

Fig. 6 Applicability of Partial Equilibrium and General Equilibrium techniques in policy research

General equilibrium has the more ambitious goal of finding a commodity market *tétonnement* where partial equilibrium assumptions do not apply. General equilibrium seeks to explain the price and quantity effects of whole economies, which are composed of many individual commodity markets. As the production of commodities is interlinked and the raw materials of each production unit comprise the output commodities of other industries, the demand of the downstream industries is the derived demand of the upstream industry. Indeed, in practice many complex industrial feedback loops occur. Furthermore, if raw materials, labour or capital are constrained then the producers in each market need to compete for scarce resources and bid for raw materials. The *tétonnement* of each market is contemporaneously settled in concert with all of the other markets. This compound effect accounts for the upward sloping supply curve.

Generic general equilibrium models have the same consumer utility and production functions, market clearance and resource constraints as partial equilibrium models. The one additional feature of a general equilibrium model is an income balance where the prices of commodities multiplied by the commodity volumes is equal to (or less than) the prices of the resources multiplied by the volumes of resources. In the field of optimised market models this relationship is called the Main Theorem of Linear Programming.

The analysis of national and global affairs has increasingly required general equilibrium models with bilateral trade to allow countries to change their competitive positions. In such models, changes to the demand curves of commodities have a major effect on the supply curves, and the imports and exports of countries have a major effect on growth rates. As a result, growth is output, calculated endogenously, rather than an exogenous input as in partial equilibrium. Most major countries in the world have developed models for World Trade Organisation, GATT and Free Trade Agreements, economic integration, taxation policies, public finance, development strategies, energy security and greenhouse gas pollution policies.

4.2 Computable General Equilibrium tools for policy research

As noted above, government policy makers often look to the political economy of classical and neoclassical economics to help understand the price, volume and spatial effects of complex policies. Computable General Equilibrium (CGE) tools have become one of the main ways of evaluating the effect of global policy proposals. As shown in Figure 7, this paradigm of developing spatial policy insights exists within an internally consistent framework of neoclassical economics. Policy makers draw upon this analytical framework, which rests within their political economy and social and market (or central planning) assumptions.

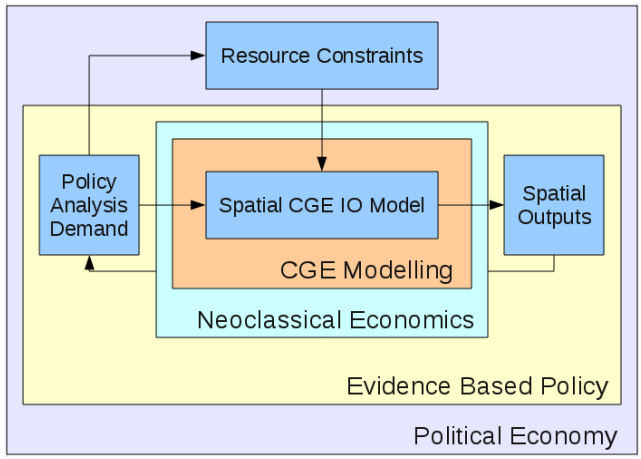

Fig. 7 Computable General Equilibrium (CGE) Modelling exists within the Neoclassical paradigm and within the overall Political Economy

The important caveat, referred to above, is that despite the apparent mathematical beauty of neoclassical policy research, these outcomes are never complete and only ever a sensitivity scenario in the journey of emulating the complex and changing global marketplace.

4.3 General limitations of CGE tools

We are at a cusp in history that makes innovation in evidence driven policy and computable general equilibrium for constrained resource development important and timely. Major philosophical, economic, behavioural and security changes are taking place in Western societies. For example, the great Western dreams of expansion and unlimited resources, in the past through force of arms if necessary, is evolving to a new type of sustainable dream. New regionally disaggregate policy modelling platforms are needed for these emerging times of heavily constrained and symbiotic global growth.

Traditional computable general equilibrium (CGE) models are a set of simultaneous equations that can be solved to calculate the equilibrium balance of an economy or set of economies. These equations that describe the economy, international trade, technology and

resource constraints of labour, capital and other critical limits. There are four main groups of equations: prices and price elasticities, production and trade, economic actors (households, enterprises, government, and a "rest of the world" institution) and constraints for factors of production and commodities that have to be satisfied for the system as a whole.

The use of such models requires many specialist mathematical algorithms. In addition, there can be optimisation limitations where economists, engineers and industrial ecologists apply constraints to simulate policy options by solving the complex interactions between different technological processes and labour markets within constraints.

The value of CGE models as an internally consistent neoclassical paradigm has been discussed. More specifically, CGE quantity and price models implicitly assume that democracy and free markets are the best form of social organisation and that at an aggregated level everyone has the same perception of utility in personal consumption and will make rational decisions. This leads to one of CGE's major weaknesses, that the construction of synthetic market models and the evidence used to do this is embedded with assumptions. This is the same charge often levelled at central planners, which can never have sufficient and timely information to make their decisions reliable.

As we have seen in the failures of neoclassical economics, the paradigm may easily be (or become) delaminated from reality. Economics is not a science based on immutable laws. It can only ever be a consistent discipline of practice with working assumptions that have proven generally valid in the past. However, the past is not always a reliable guide to the future (Popper 1959). Quite often assumptions become invalid and sometimes the body of policy makers doesn't notice this happening. At this point the paradigm diverges from reality. America's financial crisis showed that neither individual nor collective behaviour could be reliably predicted by sets of equations. Markets are subject to failure due to behavioural factors such as the breakdown of enlightened self interest, which is an article of faith in the dogma of self-regulation, and not being fully accountable for the outcome of one's actions, which is called "moral hazard."

One of the reasons that traditional CGE modelling delaminates from reality is that its assumptions about utility and welfare maximisation, measured by the expansion of consumption, are rationalist generalisations. At times when individuals and, even more importantly, institutional stakeholders behave in different ways then these assumptions can become unjustified. Any numerical policy research needs to be supplemented with an understanding of the values and ideas, alliances, brokerage and compromise of the strongly competing stakeholder institutions that have large resources to influence policy outcomes. It is necessary to evaluate the same policies with reference to the tools of political economy, ideology, moral philosophy and influence analysis as Lorman & Van Groningen (2009) note: "This capacity to engage and shape arrangements is greatly influenced by their command over resources. Those with the greatest command over resources have the greatest potential to influence policy outcomes."

Those who criticise the paradigm of consumption growth are equally scathing of CGE models as being tools of a "cult of growth" that conveniently justify growth policies (Lowe 2009).

However, this criticism of neoclassical economics and CGE models may be largely misplaced because constraints on resource usage from natural endowment scarcity and specific policy implementation (for example, to control emissions) means that the dual solution provides the very efficiency in resource utilisation that policy makers seek when putting a price on resources. The value of CGE policy tools is in showing that restructuring societies from unconstrained growth to constrained growth can achieve the necessary auto-stabilising goals through democratic and market means rather than through quantitative regulation and central planning mechanisms.

5. Policy Research Process

The traditional process for policy making is to set the agenda; formulate policy options; select policy instrument; implement; monitor; evaluate; review; and terminate (Sutcliffe & Court 2005, p.9; Lorman & Van Groningen 2009; Young & Quinn 2002, pp.13-4).

Figure 7 (above) showed how policy making occurs within the complex social environment formed by prevailing economic and political philosophies and a suite of influential institutions. The foregoing discussion has shown that evidence driven policy is itself a function of political economy and the acquiescence, or not, of policy makers to such a transparent process. However, it appears that policy makers have increasingly more onerous responsibility to demonstrate their accountability for policy making as Western societies continue evolving to monitored democracies. In turn, this can be expected to lead to the more frequent use of evidence driven policy techniques.

Evidence driven policy has obvious application in clinical testing and other scientific experiments where the deductive theory of falsification holds. It also has significant benefit in other areas of society where the scenarios are less experimentally clear and the objective theory of evidence holds. For example, in policy areas such as economics, health, education, law and defence where a great number of dependencies exist, variables can rarely be held constant *ceteris paribus* as is done in controlled scientific experiments, and the effluxion of short periods of time inevitably brings additional changes to the basis of the policy research.

From the above discussion it may be appreciated that a key requirement in the process of evidence-based policy is for due diligence research and debate to maximise the probability that a proposed policy is both feasible and the best policy. In this regard, consistency of the evidence is extremely important. For example, developing a historical analysis of the political economy of the policy area along with economic modelling for future scenarios of the policy.

This can be generalised into a framework for policy research, occurring within a process of evidence driven policy, as shown Figure 8.

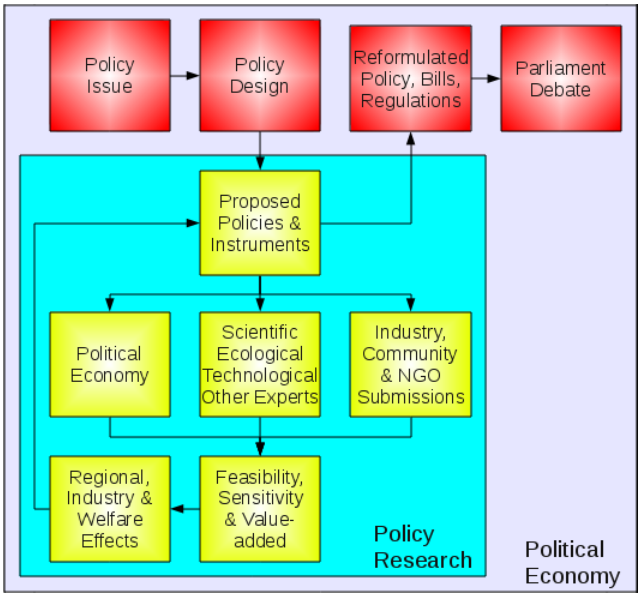

Fig. 8 Evidence Driven Policy

The first phases of "Policy Issue" and "Policy Design" are where policy makers identify the key issue and design hypothetical policies, interventions and instruments. This phase of setting the agenda seeks to identify the reasons why the issue is important, competing definitions of the problem, potential policy instruments; the steps ahead; and the power blocs and the stakeholder engagement required for alliances, brokerage and compromise.

Computable General Equilibrium policy tools find their place in the second stage of the policy forming process, namely, "Policy Research". In this phase, hypothetical policies are submitted to testing. Additional iterative research is undertaken to establish what needs to be done; identify a range of potential intervention responses; potential instruments; institutions that will implement the policy; identify individuals, institutions, industries and regions that will be affected; and to provide information to help achieve stakeholder institutions support.

The vast number of policy instruments required for the fine tuning of policy implementation means that high level policy research tools such as CGE models need to be carefully finessed and the risks documented carefully.

5.5 Policy risks

There are two types of risk: the systemic risk of being unable to fully represent the real world in a model; and non-systemic or ordinary uncertainties associated with the economic environment.

5.5.1 Systemic modelling risks

As for all professionals, policy modellers' prima facie duties include integrity, objectivity, an absence of any conflict of interest, possession of the necessary skills and competence, and processes for care and due diligence. The duty of care includes an appreciation of misleading (or deceptive) assumptions, including misleading by omission.

Wise hands in policy formation recognise first and foremost that any projection or forecast is a matter of opinion and judgement. Instead of seeking a specific numerical result, policy makers look for reasoned and sustainable assumptions and a systematic modelling process. For their part, those preparing the model specification need to appreciate that their audience's understanding of the assumptions is essential for their proper assessment of the information contained in the model. Therefore, specialists and experts preparing models need to take as much care with the formation and publication of the assumptions as they do with the policy research results.

5.5.2 Non-systemic modelling risks

As there is little practical certainty to be found in any single-point or stand-alone scenario, there is no point looking to one or other scenario as an immutable outcome. Nevertheless, there is considerable value in understanding the differences between scenarios in order to develop a feel for the patina of intensity in economic responses to policy. This can be achieved with a narrow range of scenarios that highlight risks while avoiding the meaninglessness of a range of scenarios that is either too wide or narrow.

5.5.3 Communication risks

Due to a pervasive human behavioural fallibility, many people act on the assumption that the middle value of a table or range is the most likely value. As a result, the way results are read by the intended audience is also important and measures need to be taken to ensure the presentation of results is not misleading. Rather than extensive tables, the most probable outcomes and variables that have a significant impact on these results can be discussed.

5.6. Public exposure of policy

A number of the components of Figure 8 relate to public input in the policy making process. As the great deductivists like Popper and Kuhn surmised, exposure of expertly prepared evidence-based research to peer review and, ultimately, to an open and transparent process of public criticism provides a fiery proving ground for assuring that a proposed policy is both feasible and the best policy. In particular, it is often only at the stage of public exposure that issues of social equity and justice are appropriately weighed, for example, doing the most for the majority while at the same time looking after the least well off as argued by Rawls (1972).

Prior to public exposure, the process of developing expert opinion for evidence-based policy usually relies on normative principles of systematic practice in the respective profession, be it economics, law, engineering or another profession. Ironically, while systematically applying inductivism throughout evidence-based policy, enlightened professional practice complies with strict deductivist principles in claiming only to represent current best working hypotheses and shunning any ambit that these professional hypotheses be regarded as a

science of theories and laws.

Lastly, evidence based policy is always at risk of being subverted and the “policy makers for policy making” need to be ever vigilant of degenerate policy driven evidence replacing evidence driven policy). This is selective or manipulated evidence provided to justify or promote a particular policy. For example, Thomas Kuhn showed in *The Structure of Scientific Revolutions* (1962) that vested interest groups will invest large resources in defending the status quo. Bryson & Mobray (2005) highlight the need for high level impartiality and a passion for diligent governance to eliminate conflicts of interest.

7. Conclusion

This paper addresses evidence driven policy making, which is an increasingly used policy response to complex multidisciplinary issues in policy and strategy. The world's biggest such process has been used to illustrate many controversies associated with this technique. This is the United Nations Framework Convention on Climate Change (UNFCCC) development of policy to deal with global warming.

Foundations for evidence driven policy in Service Science game theory trust strategies and the evolution of Western societies toward monitored democracies were identified. The influence of two deductivist approaches to policy in the evolution of society, those of Sir Karl Popper and Thomas Kuhn, were investigated. It was shown that deductivism and falsification are widely accepted as the best approaches to scientific progress and the more open a society or business is then the more successful it may be. However, in practice these cannot be applied to social issues or are in general too disciplined for human beings, who are not exclusively rational beings.

A viable albeit controversial complement to deduction was identified, which is evidence based induction. The objective theory of evidence was developed from Popper's World III of objective knowledge. In order for evidence-based processes to be valid and form a practical working hypothesis or normative theory, the evidence must be highly consistent. In policy, the evidence needs to derive from and be part of a consistent body of political economy. It was shown that Bayesian inductive inference provides the mathematical foundation for evidence based induction and the objective theory of evidence. It was also argued that this provides the understanding of why policy makers submit their draft policies for feasibility evaluation.

It was shown that conservative and liberal political perspectives have a major influence on the policy making process, with liberals favouring evidence driven policy and conservatives often prepared to be more expedient. It was also shown that political conservatives need to be vigilant of their paradigm's vulnerability to degenerative psychopathic behaviour.

The identification of conservative politics with climate scepticism in Western societies such as America and Australia was contrasted to the absence of this congruity in conservative European politics. It was shown that the Copenhagen embarrassments for evidence driven policy were but a hiatus and that the compelling outcomes from the evidence driven policy

processes have brought the U.S. Senate to the cusp of accepting America's future growth will be subject to constrained resources of the global commons.

Neoclassical economics provides the body of consistency for policy makers that is so much a part of the objective theory of evidence and evidence driven policy. For this reason, there is considerable poignancy in the controversy that neoclassical economics was neither able to predict nor solve the 2009 Global Financial Crisis. It was shown that a key reason for this failure was that neoclassical policy and models placed insufficient importance on debt neutrality and closing policy and models for households and socio-economic groups.

Challenges to the neoclassical paradigm have been investigated and it was concluded that neoclassical economics continues to have an important role in the consistency of evidence driven policy. However, the lesson of the Global Financial Crisis is that neoclassical economics is not prescriptive but illustrative. Policy makers have no easy mathematical solutions and continue to be faced with the inescapable feature of their art being its messiness.

The role of policy research tools within evidence driven policy was investigated. Computable General Equilibrium (CGE) was shown to find its role in policies where countries are linked by trade. However, it was shown that in using CGE tools it is important to be cognisant of the great weaknesses, as well as the great strengths, that derive from its neoclassical heritage.

The above conclusions were used to construct a generic policy research process placing emphasis on the consistency of political economy, neoclassical economics, Computable General Equilibrium Policy tools, systemic and non-systemic policy modelling risks, and public exposure of policy during and subsequent to policy research.

Notes and references

‡1 58% is calculated as 90% x 60% + (100%-90%) x (100%-60%)
‡2 93% is calculated as 90% probability that the modelling correctly shows a policy is feasible if it is indeed feasible x 60% probability of a policy being feasible regardless of other factors / 58% probability of a positive result regardless of other factors

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back back

Event	**18th International Input-Output Conference**
Author	**Stuart John Nettleton**
Title	**Recent controversies in neoclassical modelling and developments in Evidence-Driven Policy**
Category	**Input-output analysis for policy making**
Co-Authors	
Accepted	**yes, accepted**
Abstract	**2343 chars (max: 5000 chars)**

The use of Computable General Equilibrium modelling in evidence-based policy requires an advanced policy making frame of reference, advanced understanding of neoclassical economics and advanced operations research capabilities. This paper examines developments in the policy making frame of reference. The process of evidence-driven policy places importance on the validation of potential policies using models. At national, bilateral and multilateral levels, policy analysis has increasing relied on neoclassical computable general equilibrium models having substantial precedence. Bayesian analysis suggests that a policy which survives a validation test using such a model has a much better chance of being successful than a policy that fails such a test. Yet the 2008-9 Global Financial Crisis demonstrated that policies verified with neoclassical models neither predicted the Global Financial Crisis nor were able to address it. Governments across the world used massive Keynesian stimulus to restabilise economies. Neoclassical models became much maligned within Keynesian and behavioural economics circles. This paper investigates the continuing role of neoclassical models in evidence-driven policy with reference to the deductivism of Sir Karl Popper and

Thomas Kuhn, inductivism and the controversial objective theory of evidence. While policy making has always been messy, in recent decades policy makers may have succumbed to the human fallibility of justifying pragmatism with simplified ideological paradigms that inappropriately place over-reliance on neoclassical free market mathematical models because these models are self-reinforcing of the ideology. It is suggested that future policy making will be even messier, with policy makers placing less importance on such simplified paradigms and taking more responsibility for managing plurality in the political process. It is concluded that neoclassical models will continue to have a role in testing policies but those features of neoclassical models that led to the failures in understanding the Global Financial Crisis will need to be addressed. For example, to be relevant such models will need to close for both households and investment and be cognisant of distributional effects such as the sweep of income to the top 5% of consumers through wage and taxation policies.

Full paper 101_20100429011_100429SNPolic.pdf

Days for presentation
Sun, 20/Jun/2010
Mon, 21/Jun/2010
Tue, 22/Jun/2010
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Thu, 24/Jun/2010
Fri, 25/Jun/2010

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Input-Output 2010

18th International Input-Output Conference
20-25 June 2010 • Sydney Australia

Conference Book

Left: Sydney Harbour Bridge during the September 2009 dust storm

Right: Aerial view of Broken Bay, directly north of Sydney

WELCOME MESSAGE

On behalf of the University of Sydney, I welcome you to the 18th International Conference on Input-Output Economics to be held in Sydney from 20-25 June 2010.

The theme of this conference will be "Re-thinking economic growth towards sustainability and wellbeing"; it reflects important concerns that many people harboured throughout the past few years, but also reflects a major challenge we are facing: To avert dangerous environmental change whilst being able to ensure well-being for the world's people.

Input-output techniques have proven extremely versatile and powerful tools for decision-makers. In particular, environmental applications of input-output models have enjoyed enormous popularity in recent years. However, we still have a lot to do in making input-output tools more widely known across non-expert circles, and remove barriers to the development of understanding and appreciation of, and trust in the results that input-output models provide.

This conference provides great opportunities. To the researcher, it brings an environment in which exciting new ideas can be aired and discussed. For the practitioner, it provides a forum in which the strengths of our input-output technique can be demonstrated to people searching for solutions to their problems. For students, it is perhaps the best opportunity to get to know well-known academics, and look for exchange programmes and scholarships. For members of the corporate and governance worlds, it may even represent a hunting ground from which to pluck young bright talents.

I invite you to read our attractive programme, register your participation, and experience for yourself the friendly and stimulating atmosphere that is so typical of every input-output conference.

I also invite you to take the opportunity of your visit to look beyond the conference. The University of Sydney is Australia's first university, and features a beautiful campus as well as world-class research and education. The city of Sydney with its blue shining harbour and golden beaches is a true jewel that one should see once in a lifetime. And why not spend a few more weeks and travel around the amazing Australian continent that is home to unique wonders one cannot experience anywhere else.

I look forward to seeing you in Sydney in 2010.

Manfred Lenzen
Professor of Sustainability Research
Chair of the Local Organising Committee

The 18th International Input-Output Conference in Sydney took more than 2 years to organise, starting from the initial bid to the International input-output Association (IIOA), to finally putting in place all procedures required for a successful event.

This conference would not have happened without the support of volunteers in the Local Organising Committee (LOC), and members of the Scientific Program Committee (SPC). On behalf of the LOC and SPC Chairs, the IIOA and all conference delegates, a heartfelt thank-you to a dedicated and effective team!

Local Organising Committee

Chair: Manfred Lenzen

Acting Chairs: Jodie Gonzalez Jennings and Elaine Fillie

Committee members:

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Winton Evers
Lachlan Feggans
Barney Foran
Alejandro García
Arne Geschke
Bonnie McBain
Daniel Moran
Joy Murray
Shelly Page
Marguerite Pettit
Fabian Sack

For your assistance, local committee members will be recognisable at the conference in a white shirt with the main conference logo printed on the back.

The members of the Scientific Program Committee are listed in the Book of Abstracts.

With many thanks

Printing for the conference provided by Fuji Xerox Australia on responsibly procured paper.

The LOC is also very grateful for the support of Winton Evers:

Chair:

José M. Rueda-Cantuche
Institute for Prospective and Technological Studies
Joint Research Centre's European Commission, Spain

Co-chair:

Klaus Hubacek
University of Leeds, United Kingdom

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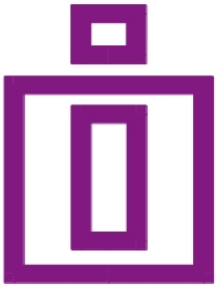
18th International Input-Output Conference

CONFERENCE PROGRAM

20/Jun/2010 - 25/Jun/2010



International Input-Output Association
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SESSION PLAN

Sun, 20/Jun/2010

17:00 - 20:00 *Welcome Reception and Registration*

Mon, 21/Jun/2010

08:30 - 09:00 *Late registrations only*

09:00 - 09:30 *Opening Ceremony and Welcome to Country*
Eastern Avenue Lecture Theatre
Geoffrey J. D. Hewings (President of the IIOA),
José M. Rueda-Cantuche (Chair of the SPC),
Klaus Hubacek (Co-chair of the SPC),
Manfred Lenzen (Chair of the LOC),
Jodie González Jennings (Co-chair of the LOC)

09:30 - 10:30 Plenary Session 1

- Location: **Eastern Avenue Lecture Theatre**
  Topic: **Sustainability in Economics**
  Chair: Joerg Beutel

1. Is there entropy in an economy? Revisiting an early concept of sustainability introduced by Nicholas Georgescu-Roegen
   by *Utz Peter Reich*

10:30 - 11:00 *Coffee Break*

11:00 - 12:30 Parallel Session 1

- Location: **Eastern Avenue Lecture Theatre**
  Topic: **World Input-Output Database I: Contruction issues**
  Chair: Erik Dietzenbacher

1. Joint Estimation of Supply and Use Tables
   by *Umed Temurshoev, Marcel P. Timmer*

2. An Empirical Evaluation of Methods to Estimate Use Tables of Imports
   by *Bart Los*

3. The construction of input-output tables and the use of supply-use tables in input-output analyses: a review
   by *José Manuel Rueda-Cantuche, Joerg Beutel*

2. Assessing the Potential Sudden Reduction of the Supply of Oil and Gas on the Different Sectors of the Iranian Economy
   by *Ali Asghar Banouei, Jillian Banouei, Mehdi Karami, Seyed Iman Azad*

3. Macroeconomic impacts of the bio-fuel sector in Canada
   by *Kakali Mukhopadhyay, P. Thomassin*

- Location: **Lecture Theatre 2, School of Physics**
  Topic: **Input-output applied to social issues II**
  Chair: Cristela Goce Dakila

  1. A non-linear input-output model for measuring the employment effect of changes in final demand: an approach based on the employment elasticity
     by *Bin Wang, Jian Xu*

  2. Evaluating Chinese Household Consumption Potential, Their Export Replacement Capacity and Pulling Effect on Chinese Economic System amid the 2008 World Financial Crisis
     by *Xiuli Liu*

  3. Welfare Effects of Regional Transport Infrastructure Improvement in a Developing Economy : SCGE Approach
     by *Cristela Goce Dakila*

- Location: **Lecture Theatre 5, School of Physics**
  Topic: **Sector specific analyses: manufacturing**
  Chair: Yuan Jianwen

  1. The Effects of Nanotechnology Implementation on Production Costs and Employment: An Input-Output Simulation
     by *Nooraddin Sharify, Abdolreza Sharifi, Fatemeh Sharify*

  2. The industry similarity in input-output system of China in 1981-1995: Application of dual scaling and fuzzy clustering
     by *Xue Fu*

  3. Market Access, Supply Access and Geographic Concentration of Manufactures in China: A Interregional Input-output Approach
     by *Zhao Zhao, Shi Minjun, Jing Yang*

- Location: **Room 414, School of Physics**
  Topic: **Historical perspective of input-output analysis**
  Chair: Fidel Aroche

  1. Recent controversies in neoclassical modelling and developments in Evidence-Driven Policy
     by *Stuart John Nettleton*